
पश्मीना उत्पादों की पहचान,
लेबलिंग एवं मोहरांकन
(पहला पुनरीक्षण)

Identification, Labelling and Marking
of Pashmina Products
(First Revision)

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wool, Wool Products and Textile Floor Coverings Sectional Committee had been approved by the Textiles Division Council.

This standard was originally published in 2019. The first revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

- a) Scope of the standard has been modified.
- b) Tolerance for fibre composition in pashmina blends has been modified.
- c) Requirement and tolerance for guard hair has been modified.
- d) Preliminary analysis of pashmina fibre has been excluded.
- e) Sampling plan has been modified.
- f) Surface morphology of pashmina fibre has been updated.
- g) Reference standards have been updated.

India contributes only about 1 percent of the world's *Pashmina*, but the *Pashmina* produced in India is best of the whole and occupies unique position. In India, *Pashmina* is obtained from Ladakh region, Lahul and Spitti valley of Himachal Pradesh, Uttar Kashi, Chamoli and Pithargarh districts of Uttarakhand. The *Pashmina* obtained from Ladakh region is known as *Changthangi Pashmina* whereas that obtained from Himachal Pradesh and Uttarakhand is known as *Chegu Pashmina*.

Due to restricted availability and high prices, adulteration of *Pashmina* with sheep wool/ultrafine merino wool is a common practice by manufacturers. Due to this, common consumers are deprived of the genuine *Pashmina* products. This has also hampered the growth and development of *pashmina* trade.

This standard has been formulated in order to curb the practice of adulteration of *Pashmina* products and to preserve the culture and heritage of *Pashmina*.

Technical assistance has been derived from research work carried out by Sher-e-Kashmir University of Agriculture Sciences and Technology of Kashmir (SKUAST-K) and ICAR-Central Sheep and Wool Research Institute, Avikanagar on the subject.

In formulation of this standard, technical assistance has also been derived from following International Standards on the subject: -

ISO 17751-1 : 2016	Textiles — Quantitative analysis of <i>cashmere</i> , wool, other specialty animal fibers and their blends — Part 1: Light microscopy method.
ISO 17751-2 : 2016	Textiles — Quantitative analysis of <i>cashmere</i> , wool, other specialty animal fibers and their blends — Part 2: Scanning electron microscopy method.
ISO 18074 : 2015	Textiles – Identification of some animal fibres by DNA analysis method — <i>Cashmere</i> , wool, yak and their blends.

The composition of the Committee responsible for the formulation of this standard is given in Annex G.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounding off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

IDENTIFICATION, LABELLING AND MARKING OF *PASHMINA* PRODUCTS

(*First Revision*)

1 SCOPE

This standard specifies testing methods for identification, labelling and marking of *Pashmina* products by using the light microscopy (LM), the scanning electron microscopy (SEM) and DNA-polymerase chain reaction (PCR) method. This standard is applicable to raw fibre, sliver, yarn, dyed/processed fabrics and finished products made of at least 90 percent of pashmina fibres.

NOTE — The product shall be marked and labeled as pashmina product if it contains at least 90 percent of pashmina fibres in the product.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subjected to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purposes of this standard, the following definitions shall apply.

3.1 Buffer Solution — Solution used to maintain pH of reaction solution at required value.

3.2 DNA — Deoxyribonucleic acid, that exists in nuclei and in mitochondria of animal fibre cells and is composed of a linear array of 4 bases (Adenine: A, Thymine: T, Guanine: G and Cytosine: C).

NOTE — The DNA sequence is identical and intrinsic for each animal fibre.

3.3 DNA Amplification — Amplification of the specific fragment of DNA by the PCR method.

3.4 DNA Polymerase for PCR Method — Heat-stable DNA polymerase that is used for PCR and has no proof reading activity.

3.5 Fibre Surface Morphology — Sum of the physical properties/attributes characterizing the fibre surface.

Example — The fibre surface morphology includes scale frequency, scale height, patterns of scale edge, scale surface smoothness, fibre evenness along its axis, transparency under light microscope/scanning electron microscope.

3.6 Gel Electrophoresis Migration — Method to detect the amplified constant length DNA fragments.

3.7 Guard Hair — The guard hair is the outer protective covering of mammals especially found in domesticated changthangi and chegu goats and are long, coarse and stiff hairs having diameter of more than 30 μ and have minimum medullation of 15 percent and above.

3.8 Laboratory Sample — Portion drawn from a lot sample according to the requirements for preparing specimens.

3.9 Light Microscope — Optical instrument used to produce magnified images utilizing visible light source.

NOTE — Types of microscopes suitable for fibre identification include projection microscopes and visual microscopic image analysers. Transmitted – light type microscopes with direct graduated scale equipped on optical lens are also applicable.

3.10 Lot Sample — Portion representative of the same type and same lot of material drawn according to the requirements from which it is taken.

3.11 Pashmina Fibre — *Pashmina* is a fine animal hair fibre obtained from the undercoat of a domesticated *Changthangi/Chegu* (*Capra hircus*) goat in India having average fibre diameter < 16 μ with zero medullation.

3.12 PCR Method — Method of the polymerase chain reaction.

3.13 Primer — Short length fragments of single strand DNA which is reaction initiator and designated as the identical/complementary sequence of 18-30 bases to DNA.

3.14 Primer for Pashmina — Primer with an identical/complementary base sequence of mitochondrial DNA of Pashmina.

3.15 Primer for Wool — Primer with an identical/complementary base sequence to mitochondrial DNA of wool.

3.16 Primer Set — Set of primer with the reaction direction of forward and reverse.

3.17 Reducing Agent — Agent that degrades animal fibres through reductive cleavage of sulphur (S-S) bonds in the fibres.

3.18 Scale — Cuticle covering the surface of animal fibres.

3.19 Scale Frequency — Number of scales along the fibre axis per unit length.

3.20 Scale Height — Height of the cuticle at the scale's distal edge.

3.21 Scanning Electron Microscope — Intermediate type of microscopic morphology observation instrument between transmitted electron microscope and light microscope which use a focused beam of high-energy electrons to generate a variety of physical information signals.

NOTES

1 The principle consists of scanning a primary focused electron beam over a whole area of interest on the surface of solid specimen and the signal derived from which is then received, amplified, and displayed in images for full observation of surface area topography of the specimen.

2 The signals obtained by a scanning electron microscope are, for example secondary electrons, Auger electrons, characteristic X-ray, etc.

3.22 Speciality Animal Fibre — Any type of keratin fibre taken from animals (hair) other than sheep.

3.23 Test Specimen — Portion taken from fibre snippets randomly cut from a laboratory sample for measurement purposes.

4 REQUIREMENTS

4.1 Diameter

The *Pashmina* fibre shall be generally non-medullated and shall have mean diameter not exceeding 16 microns. Depending upon the type of sample, the diameter of *Pashmina* fibre shall be tested as per 5.1 or 5.2 or IS 744 or their combination.

4.2 Pashmina products shall satisfy the pashmina fibre composition as declared by the manufacturer with:

- A tolerance of minus 3 percent units, plus no limit for pashmina (in case of blended/mixed products);
- In case of product (except dehaired raw fibre) made from 100 percent pashmina, a tolerance of minus 2 percent is applicable;
- In case of dehaired raw fibre bale made from 100 percent pashmina, a tolerance of minus 5 percent is applicable; and
- When tested by methods specified in this standard (see 5).

NOTE — The tolerances specified in 4.2 include guard hair.

4.3 Guard Hair

The percentage of the guard hairs in the dehaired raw material shall not be more than 5 percent and in sliver/yarn/fabric/finished product shall not be more than 1 percent.

The percentage of guard hair is determined by counting hairs/fibres of diameter more than 30 μ and medullation of more than 15 percent as per 5.1 or IS 744 or their combination.

5 QUALITATIVE AND QUANTITATIVE IDENTIFICATION OF *PASHMINA* FIBRE

5.1 Identification of *Pashmina* Fibres by using Light Microscopy Method

5.1.1 Principle

A longitudinal view image of fibre snippets representative of a test specimen is magnified to an appropriate scale/size under an optical microscope. All the fibre types found in the test specimen are identified by comparing them with known fibre surface morphologies for different types of fibres.

For each fibre type, the number and mean diameters of the fibre nippets are counted and measured. The mass fraction is calculated from the data for the number of fibre snippets counted, mean value and standard deviation of the snippet diameter, and the true density of each fibre type.

NOTE — At present, the most widely used and reliable identification techniques include the light microscopy (LM) method and the scanning electron microscopy (SEM). The SEM method shows complementary characteristics to those of LM method. The advantage of the LM method is that the internal medullation and pigmentation of fibres can be observed; the disadvantage is that some subtle surface structures cannot be clearly displayed. A decolouring process needs to be carried out on dark samples for testing. An improper decolouring process can affect the judgment of the fibre analyst.

The SEM method shows opposite characteristics to those of LM method so some types of fibres need to be identified by scanning electron microscope.

The LM and SEM methods need be used together to identify some difficult-to-identify samples in order to utilize the advantages of both methods. It has been proven in practice that the accuracy of a fibre analysis is highly related to the ample experience, full understanding, and extreme familiarity of the fibre analyst to the surface morphology of various types of animal fibres.

5.1.2 Apparatus

The apparatus may be any of the following type.

5.1.2.1 Projection microscope, comprised of a light source, a light condenser, a stage, an objective, an ocular, and a circular transparent viewing screen or non-transparent projection table with a graduated scale in millimetres. The objective and ocular shall be capable of providing at least a magnification of 500 X at the screen.

5.1.2.2 Visual microscopic image analyser, comprised of a microscope, a camera, a computer, a data acquisition card, exclusive analysing software, and a display. The objective and ocular of the microscope shall be capable of providing at least a magnification of 500 X.

5.1.2.3 Transmitted-light type microscope, comprised of a light source, a light condenser, a stage, an objective, and an ocular with a graduated scale. The objective and ocular of this type of microscope shall be capable of providing a magnification of 400 X to 500 X.

5.1.3 Materials

5.1.3.1 Microtome.

5.1.3.2 Scissors, tweezers, cleaning fabric, watch-glass, etc.

5.1.3.3 Slides and cover glasses.

5.1.3.4 Wedge scale, with divisions of 500 X magnification. A moveable linear rule-type scale finely graduated in millimetres may also be used.

5.1.4 Reagents

5.1.4.1 Liquid paraffin, with a refractive index between 1.43 and 1.53.

5.1.5 Drawing of Laboratory Sample, Conditioning and Calculation of Test Results

5.1.5.1 Drawing methods for lot samples and laboratory samples (except for ready-made garment specified in 7) shall be as per method given in Annex B.

5.1.5.2 The laboratory sample shall be conditioned for at least 4 h under the standard atmosphere stipulated in IS 6359.

5.1.5.3 Preparation of test specimens, test procedure and calculation of test results shall be carried out as per Annex C.

5.1.5.4 Surface morphology of Pashmina fibre is given in Annex D.

5.2 Identification of Pashmina Fibres by using Scanning Electron Microscopy Method

5.2.1 Principle

A longitudinal view image of fibre snippets representative of a test specimen coated with a thin layer of gold is produced by a scanning electron microscope through scanning the side surface of the test specimen with a focused incident beam of high-energy electrons, detecting signals of secondary electrons emitted by the gold atoms excited when hit by the incident electron beam, and combining the beam position with the detected signals which contain information on surface topography of the test specimen.

All fibre types found in the test specimen are identified by comparing them with known fibre surface morphologies for different types of fibres.

For each fibre type, the number and mean diameter of fibre snippets are counted and measured. The mass fraction is calculated from the data for the number of fibre snippets counted, mean value, and standard deviation of the snippet diameter and the true density of each fibre type (*see note under 5.1.1*).

5.2.2 Apparatus

The apparatus may be any of the following type.

5.2.2.1 Scanning electron microscope, comprised of a vacuum system, electronic optical system, signal collecting and imaging system, display system, and measurement software.

5.2.2.2 Sputter coater, with a gold cathode or other metal like iridium.

5.2.2.3 Low vacuum, table top scanning electron microscope.

5.2.3 Materials

5.2.3.1 Microtome

5.2.3.2 Glass tube, 10 mm to 15 mm in diameter.

5.2.3.3 Stainless-steel rod, approximately 1 mm in diameter.

5.2.3.4 Glass plate, measuring approximately 150 mm × 150 mm.

5.2.3.5 Double-sided adhesive tape.

5.2.3.6 Tweezers, scissors.

5.2.3.7 Specimen stub, aluminium or brass, 13 mm in diameter.

5.2.3.8 Razor blade

5.2.4 Reagents

5.2.4.1 Acetone (analytical grade)

5.2.4.2 Ethyl acetate (analytical grade)

5.2.5 Drawing of Laboratory Sample, conditioning and calculation of test results.

5.2.5.1 Drawing methods, for lot samples and laboratory samples (except for ready-made garment specified in 7) shall be as per method given in Annex B.

5.2.5.2 The laboratory sample shall be conditioned for at least 4 h under the standard atmosphere stipulated in IS 6359.

5.2.5.3 Preparation of test specimens, test procedure and calculation of test results shall be carried out as per Annex E.

5.2.5.4 Surface morphology of *Pashmina* fibre is given in Annex D.

5.3 Identification of Pashmina Fibres by using DNA Analysis, Polymerase Chain Reaction (PCR) Method

5.3.1 Principle

Mitochondrial DNA is extracted from animal fibre samples by using a chemical and enzyme reaction. The extracted DNA is purified by using a precipitation method and centrifuge. The purified DNA is applied for the amplification reaction of PCR method. In the PCR method, primers for pashmina, angora rabbit, yak and wool are respectively tested. If the sample is pashmina, only pashmina primer can amplify the constant length of DNA fragments. Then, the constant length of DNA fragments is detected by the electrophoretic migration method.

The sample fibres are identified by knowing whether amplification was observed or not for the tests using all primers respectively.

NOTES

1 The testing method to determine the composition of pashmina fibres in the textile products has been developed as given in clause 5.1 and 5.2. In this method, pashmina fibres are observed by microscope and identified from the shape of scales by experienced examiners. Many samples can be tested with a high degree of efficiency using this method. However, even experienced examiners have difficulties in identifying fibres, because textile products have a broad variety of colours and finishings, and there are many blends in animal fibres.

Given this situation, several testing methods to obtain the more accurate results have been investigated and developed. Among those methods, the DNA (deoxyribonucleic acid) analysis method has been found to be a practical and feasible method to identify the inherent type of animal fibres.

As it is well known, DNA is specific for animals. The DNA-PCR (polymerase chain reaction) method has recently been developed with high accuracy. A very trivial quantity of the DNA extracted from pashmina/animal fibres is amplified by PCR to yield a huge quantity of copy DNA. Mitochondrial DNA is used for this analysis because it provides greater numbers than nuclear DNA.

2 Test results for fibre identification by the DNA analysis method can be obtained with a high accuracy for the animal fibre products which were processed at lower dye concentration levels or dyed in light colours. However, when such products were processed under severe conditions or high temperatures, the mitochondrial DNA could have been damaged.

5.3.2 Apparatus

The apparatus may be any of the following type.

5.3.2.1 Thermal cycler

5.3.2.2 Refrigerated centrifuge machine

5.3.2.3 Horizontal gel electrophoresis unit

5.3.2.4 Gel documentation system

5.3.2.5 Weighing balance

5.3.2.6 Liquid handling system (micropipettes), etc

5.3.3 Preparation of Test Specimen

5.3.3.1 Textile samples is washed with 2 percent SDS (sodium dodecyl sulphate) and milli Q water (prewashing of textiles depends upon dyes used, prewash methods and number of times varies from textile to textile).

5.3.3.2 Washed samples are mixed with DNA lysis buffer and incubated at 37 °C overnight.

5.3.3.3 Proteinase K (stock 20 mg/ml) is added and incubated at 56 °C for 6 h.

5.3.3.4 DNA is extracted by standard phenol chloroform (25 : 24) followed by ethanol precipitation method.

5.3.3.5 Precipitated DNA is further purified by silica based column available commercially.

5.3.4 Test Procedure

5.3.4.1 PCR amplification is performed in 25 µl PCR reaction mixture containing 2.5 µl of 10X PCR buffer, 1.5 mM MgCl₂, 200 µM dNTP mix, 10 pM of each forward and reverse pashmina specific primers, 2.5 units of Taq polymerase and 4 µg of DNA using specified thermal profile.

5.3.4.2 Amplified PCR products are resolved on 2 percent agarose gel stained with SYBR safe stain.

5.3.5 Expression of Test Results

5.3.5.1 PCR products is observed under UV illuminator and photographs are captured in gel documentation system.

5.3.5.2 Gel picture of pre-specified size is determined using commercially available DNA ladders.

5.3.6 Drawing of Laboratory Sample and Sampling

5.3.6.1 Two test specimens are selected from the sample. When the two results are not consistent, do not adopt the results and perform another test for two specimens again.

NOTE — Annex B (except for ready-made garment specified in 7) may be used as a reference for this procedure.

5.3.6.2 PCR amplification images of *Pashmina* fibre are given in Annex F.

6 MARKING

6.1 The product(s) shall be legibly and indelibly marked with the following information on the product itself or on durable and securely attached labels:

a) Name of the product;

- b) Manufacturer's name, initials or trade-mark;
- c) Lot/Batch number and date of manufacturing;
- d) Declared composition of pashmina fibre;
- e) Instructions for storage, handling and care;
- f) Country of origin; and
- g) Any other information required by the law in force and/or by the buyer.

6.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

7 SAMPLING AND CRITERIA FOR CONFORMITY FOR READYMADE GARMENT

7.1 Lot

All pieces of the same type and composition of ready-made garment delivered to a buyer against one dispatch note shall constitute a lot.

7.1.1 The conformity of the lot to the various requirements specified in the standard shall be determined on the basis of tests carried out on the sample selected from the lot.

7.1.2 Unless otherwise agreed, the number of pieces selected at random for inspection shall be in accordance with Table 1. To ensure the randomness of selection, IS 4905 may be followed.

Table 1 Sample Size
(Clauses 7.1.2 and 7.1.3)

Sl No.	Lot Size	Sample Size	Permissible Number of Non-Conforming Pieces
(1)	(2)	(3)	(4)
i)	Up to 25	2	0
ii)	26 to 100	3	0
iii)	101 to 500	5	0
iv)	501 and above	8	1

7.1.3 Number of Tests and Criteria for Conformity

The samples selected from the lot shall be tested for requirements as specified in 4. The sample selected shall be declared non-conforming, if it does not meet any of the applicable requirements specified in the standard. The lot shall be declared conforming to the requirements of this standard if the total number of defective readymade garment does not exceed the value given in column 4 of Table 1. Otherwise, the lot shall be rejected.

NOTES

1 For sampling of fibre, sliver, yarn and fabric, clauses **5.1.5.1**, **5.2.5.1** and **5.3.6.1** shall be referred.

2 In case of fibre, sliver, yarn and fabric, all samples selected from the lot shall meet the requirement as specified in 4.

8 PACKING

8.1 The product(s) shall be packed securely so as to allow normal handling and transport without tearing and exposing the contents. Details of the packing shall be as agreed to between the buyer and the seller.

8.2 The product(s) shall be suitably packed so as to ensure protection against attack by insects and moths.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN/ISO STANDARDS

<i>IS/ISO No.</i>	<i>Title</i>	<i>IS/ISO No.</i>	<i>Title</i>
744 : 2000	Textiles — Methods for determination of wool fibre diameter, percentage of medullated fibres and kemp fibre (<i>third revision</i>)	6359 : 1971	Method for conditioning of textiles
		4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (<i>first revision</i>)

ANNEX B

(Clauses 5.1.5.1, 5.2.5.1 and 5.3.6.1)

DRAWING OF THE LOT SAMPLE AND THE LABORATORY SAMPLE**B-1 LOOSE FIBRE**

Fifty percent of the total number of packages should be sampled. Take out a bundle of fibres from at least three parts of each package. After blending them homogeneously, divide the sample into two equal portions, one portion randomly selected is retained and the other is rejected.

After mixing the retained portion to ensure it is homogenized, divide it again into two equal portions in the same way. Reject one portion (selected at random).

Continue the subdivision procedure until about 20 g of fibres remain; this is the lot sample.

Divide the 20 g fibre lot sample into two portions — use one portion as the laboratory sample and retain the other as a spare sample.

B-2 SLIVER

Take one 30 cm long sliver from a ball top or a sliver can. Randomly, take four such slivers altogether. Strip each of the four slivers in its longitudinal direction to form another sliver, which is the laboratory sample. Retain the remaining portions as spare samples.

B-3 YARN

Take twenty 20 cm long *Pashmina* yarn segments from each of ten different cones or skeins to obtain 200 *Pashmina* yarn segments.

Cut the yarn bundle in the middle to get two portions — use one portion is used as the laboratory sample and retain the other as a spare sample.

B-4 WOVEN FABRICS

Take three trapezoidal samples, each measuring 5 cm × 10 cm (warp × weft), from places which are 10 cm from the edges of the fabric. For each sample, mark its warp and weft directions respectively. (Cut at least the integral multiple of a complete pattern in the case of fabrics where there is a definite repetition of the pattern.) Cut along the weft direction from the middle of each fabric sample and divide it into two portions — use one as the laboratory sample and retain the other as a spare sample.

B-5 KNITTED FABRICS

Take three samples, each measuring 5 cm × 10 cm (transverse × longitudinal). Avoid rib sections such as cuff or bottom parts. Cut each sample from the middle along the longitudinal direction into two portions — use one as the laboratory sample and retain the other as a spare sample.

ANNEX C

(Clause 5.1.5.3)

PREPARATION OF TEST SPECIMENS, TEST PROCEDURE AND CALCULATION OF TEST RESULTS FOR LIGHT MICROSCOPY METHOD

C-1 PREPARATION OF THE TEST SPECIMENS**C-1.1 Number of Test Specimens**

Prepare one or more slides so that at least 1 000 fibres shall be identified.

C-1.2 Preparation of the test Specimens**C-1.2.1 Loose fibre**

C-1.2.1.1 Place the laboratory sample flat on the test table, pick up approximately 500 mg of fibres randomly on not less than 20 spots with tweezers from the top and bottom sides of the sample. Blend them homogeneously and divide them into three equal portions. Sort these drawn fibres into basically parallel fibre bundles.

C-1.2.1.2 Cut each fibre bundle in the middle with a microtome to get approximately 0.6 mm long fibre snippets. Cut only once in each of the fibre bundles.

C-1.2.1.3 Place all the fibre snippets on the watch glass, drop an appropriate amount of liquid paraffin, stir with tweezers to make the suspended snippet liquid distribute uniformly on the watch glass, then take an appropriate amount of this specimen blend and put it on the slide. Cover with a cover glass.

C-1.2.2 Sliver

C-1.2.2.1 Cut the laboratory sliver sample into three sections. Take out an appropriate amount of the fibre bundle in the longitudinal direction from each sliver section.

C-1.2.2.2 Cut in the middle of each fibre bundle to obtain approximately 0.6 mm long fibre snippets with a microtome. Cut only once in each fibre bundle.

C-1.2.2.3 Other operating procedures are the same as those stipulated in C-1.2.1.3.

C-1.2.3 Yarn

C-1.2.3.1 Divide the laboratory sample into three equal portions.

C-1.2.3.2 Cut each portion in the middle with a microtome to obtain approximately 0.6 mm long fibre snippets. Cut only once in each yarn portion.

C-1.2.3.3 Other operating procedures are the same as those stipulated in C-1.2.1.3.

C-1.2.4 Woven Fabrics

C-1.2.4.1 If the warp and weft yarn share the same composition, all the yarns unravelled from a square sample of a complete pattern may be cut to obtain an appropriate test specimen. For those fabric samples composed of different compositions of warp and weft yarns, unravel the warp and weft yarns and weigh them separately. (If the fabrics have a definite repetition in the pattern, unravel at least the integral multiple of a complete pattern).

C-1.2.4.2 Cut from the parallel yarn portion in the middle with a microtome to obtain approximately 0.6 mm long fibre snippets. Cut only once in each yarn portion.

C-1.2.4.3 Other operating procedures are the same as those stipulated in C-1.2.1.3.

C-1.2.5 Knitted Fabrics

C-1.2.5.1 Unravel at least 25 yarn segments from the laboratory sample for woollen knitted fabrics. Unravel at least 50 yarn segments for worsted knitted fabrics. Cut each yarn portion in the middle to obtain approximately 0.6 mm long fibre snippets. Cut only once in each yarn portion.

C-1.2.5.2 If, prior to analysis, Soxhlet extraction in light petroleum (boiling point 40 °C to 60 °C) is carried out to remove excess surface greases or oils, it shall be reported.

C-1.2.5.3 Other operating procedures are the same as those stipulated in C-1.2.1.3.

C-1.3 Decolouring of the Laboratory Sample

If a decolouring process is carried out on those dark laboratory samples for which it is difficult to see the fibre morphology, prepare the test specimens according to the requirements in C-1.2. The decolouring process application shall be reported.

NOTE — The decolouring process can lead to different fibre diameters measured from the decoloured fibres than from those diameters measured from the original fibres taken from fabric or yarns prior to decolouring.

The recommended decolouring methods are given in C-1.4 and C-1.5.

C-1.4 Method 1

C-1.4.1 Prepare a sodium hydrosulfite solution with a concentration of 50 g/l. The ratio of the specimen mass to the solution is 1 : 100.

C-1.4.2 Put the sample in the solution and heat it. Observe the decolouration after appropriate heating. The decolouring time and temperature are subject to the following conditions: the scales are clear so that they can be identified, and no damage is caused to the decoloured fibres.

C-1.4.3 Wash the sample completely, then put the treated sample in a well circulated place to allow it to dry naturally.

C-1.5 Method 2

C-1.5.1 Dissolve 0.20 g of citrate and 0.9 g of sodium hydrate in 15 ml of water. Dissolve completely.

C-1.5.2 Take a 0.5 g representative test sample (yarn shall be unravelled from woven fabric samples) and put it into the fully dissolved solution.

C-1.5.3 Oscillate for 30 min at a temperature of $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ in a water-bath oscillator to ensure that all of the sample is thoroughly immersed.

C-1.5.4 Add 0.6 g of solid sodium hydrosulfite. Shake immediately after putting on the lid.

C-1.5.5 Oscillate another 10 min at a temperature of $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ in a water-bath oscillator.

C-1.5.6 Take out the sample. After washing, drying, and conditioning, the sample may be used to carry out test.

C-2 TEST PROCEDURE

C-2.1 Settings of Magnification with Micrometer Scale

Put the micrometer with a 0.01 mm scale on the stage. The 20 scales from the micrometer (0.20 mm) projected on the screen shall be precisely magnified to 100 mm which means the magnification is $\times 500$.

C-2.2 Fibre Identification and Fibre Diameter Measurement

C-2.2.1 Projection Microscope with a Graduated Scale in Millimetres on the Screen

C-2.2.1.1 The slide should be scanned in a raster pattern. This ensures that all parts of the slide are covered and avoids the possibility of any fibre being measured twice.

C-2.2.1.2 Observe and measure the diameters of the various types of fibres in the view. At the same time, identify the pashmina fibre according to fibre morphologies as given in Annex D. Measure the diameters of at least 100 fibres for pashmina. Record the number of pashmina fibres, and identify more than 1 000 fibre snippets from each test specimen.

C-2.2.1.3 For those fibres observed with diameters exceeding $30\text{ }\mu$ for pashmina, record them as guard hair. Measure their fibre diameters and record the number of such fibres. (see 4.3).

C-2.2.1.4 If a measurement falls between two divisions, take the lower of the two values.

C-2.2.1.5 Calculate the mean fibre diameter and standard deviation for a pashmina component according to Formulae (1) and (2), respectively.

$$\bar{d} = \frac{\sum (d \times F)}{\sum F} \quad (1)$$

$$S = \frac{\sum F (d - \bar{d})^2}{\sum F} \quad (2)$$

where

$\bar{d}$ = the mean fibre diameter of the pashmina component, in micrometres (μm);

d = the group diameter, d = (recorded group value + 0.5) $\times 2$, in micrometres (μm);

F = the number of fibres measured with the same diameter; and

S = the standard deviation, in micrometres (μm).

C-2.2.2 Projection Microscope Used to Measure the Fibre Diameter with a Wedge Scale or a Transparent Moveable Linear-rule-type Scale.

C-2.2.2.1 Measurement is made by moving the wedge scale with its length at right angles to the fibre image until a division coincides with one edge of the focused fibre image. The width of the fibre image is read off on the other edge of the wedge scale. When measuring an image whose edges are not in focus together, adjust the focusing so that one edge is in focus when a fine line appears and the other edge shows a white line. Measure the width from the edge that is in focus to the inside of the white line.

C-2.2.2.2 If the width of a fibre image coincides with wedge scale division and lies exactly on a millimetre division of N , the width of the measured fibre image may be assigned to either data group $N-1$ or $N+1$ depending on actual conditions. If such cases reoccur, alternately assign them to data group $N-1$ and to data group $N+1$.

C-2.2.2.3 Other operating procedures are the same as those stipulated in C-2.2.1.1 to C-2.2.1.3.

C-2.2.2.4 The mean fibre diameter and standard deviation of a given component is calculated using Formulae (3) and (4), respectively.

$$\bar{d} = \frac{\sum (A \times F)}{\sum F} \quad (3)$$

$$S = \frac{\sum F(A - \bar{d})^2}{\sum F} \quad (4)$$

where,

$\bar{d}$ = the mean fibre diameter of the pashmina component, in micrometres (μm);

A = the median, in micrometres (μm);

F = the number of fibres measured; and

S = the standard deviation, in micrometres (μm).

C-2.2.3 Visual Microscopic Image Analyser

C-2.2.3.1 Observe various type of fibres in the screen view. Measure the fibre diameter when edges of fibre in focus shows clear fine lines. Move the cursor to one side of the focused fibre, click on the left mouse button, then move the cursor to the other side of the focused fibre. Click on the left mouse button again, the fibre diameter value will be automatically recorded after measurement. Test result will be automatically calculated and recorded in the report sheet.

C-2.2.3.2 Other operating procedures are the same as those stipulated in C-2.2.1.1 to C-2.2.1.3.

C-2.2.4 Transmitted-light Type Microscope

Proceed as described in C-2.2.1, but with measuring using the graduated scale of the ocular.

C-3 CALCULATION OF TEST RESULT

C-3.1 Calculate the mass fraction of pashmina component using formula (5).

$$w_i = \frac{N_i(D_{i2}S_{i2})p_i}{\sum [N_i(D_{i2}S_{i2})p_i]} \times 100 \quad (5)$$

where

w_i = the mass fraction of the pashmina component, in percent;

N_i = the number of fibres counted for the pashmina component;

S_i = the standard deviation of mean fibre diameter of the pashmina component, in micrometres (μm);

D_i = the mean fibre diameter of the pashmina component, in micrometres (μm); and

ρ_i = the density of the pashmina component in grams per millilitre (g/ml).

NOTE — The density of pashmina fibre is 1.31 g/cm³.

Take the mean value of calculations of the two tests as the test result. If the difference between two tests is larger than 3.0 percent, the third specimen shall be tested. In such a case, the mean value of the three tests is taken as the test result. Test result of fibre content is rounded to one decimal.

C-3.2 Calculate the mass fraction of pashmina fibre component in woven fabric samples through formula (6).

$$w_i = \frac{W_{iT} \times m_T + W_{iW} \times M_W}{m_T + m_W} \times 100 \quad (6)$$

where

w_i = the mass fraction of the pashmina component in the woven fabric sample, in percent;

w_{iT} = the mass fraction of the pashmina component in the warp yarns of the woven fabric sample, in percent;

m_T = the mass of the warp yarns in the woven fabric sample;

w_{iW} = the mass fraction of the pashmina component in the weft yarns of the woven fabric sample, in percent; and

m_W = the mass of the weft yarns in the woven fabric sample.

ANNEX D

(Clauses 5.1.5.4, 5.2.5.4, C-2.2.1.2 and E -2.1.1)

SURFACE MORPHOLOGY OF PASHMINA FIBRE

D-1 ASSESSMENT OF SCALE DENSITY

D-1.1 In order to differentiate the *Pashmina* fibres from that of adulterant wool fibre, the number of scales per 100 micron of the length shall be measured using light microscopy or scanning electron microscopy.

D-1.2 Count the number of scales per 100 microns from the photographs referring the bar length at the bottom of the photomicrograph.

D-1.3 The surface density of scales is 10 in case of wool while it is 6-7 in case of *Pashmina* fibres.

D-1.4 Light microscopic studies and scanning electron microscopy method studies on traverse and longitudinal structure of *Pashmina* fibres are given in Fig 1 to Fig 4.

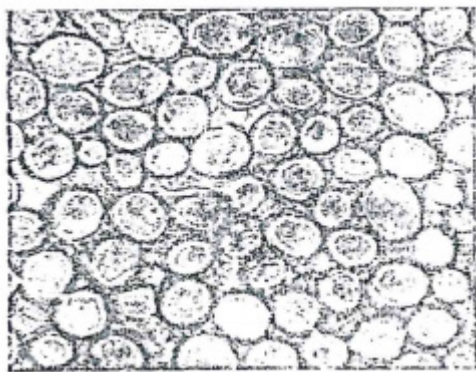


FIG. 1 A PASHMINA LADAKH WHITE

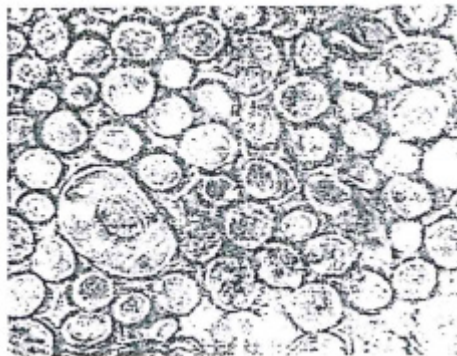


FIG. 1 B PASHMINA LADAKH BROWN

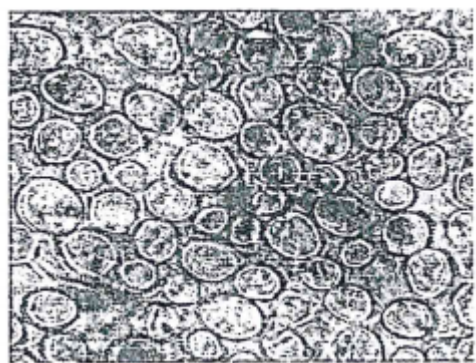


FIG. 1 C PASHMINA LADAKH BROWN
(HAND DEHAIRD)

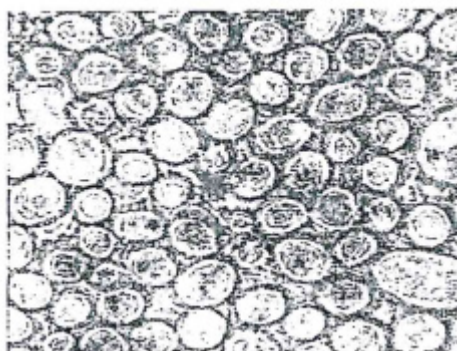


FIG. 1 D PASHMINA LADAKH WHITE
(HAND DEHAIRD)

FIG. 1 LIGHT MICROSCOPIC STUDIES ON TRAVERSE CROSS-SECTION OF PASHMINA FIBRES

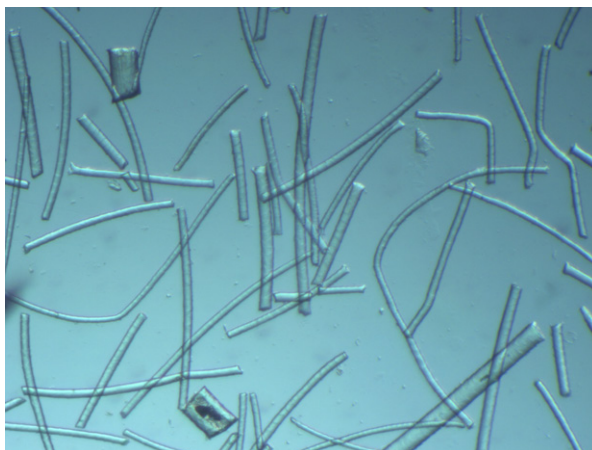


FIG. 2 A PASHMINA

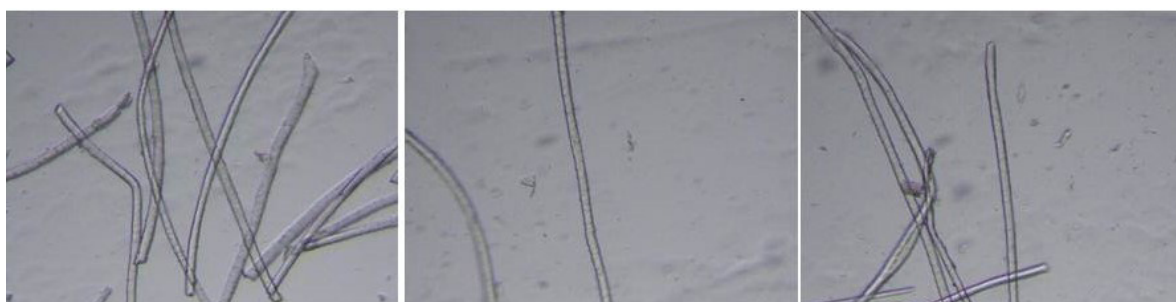


FIG. 2 B LIGHT MICROSCOPIC IMAGES OF RAW PASHMINA FIBRES



FIG. 2 C LIGHT MICROSCOPIC IMAGES OF PASHMINA FIBRES FROM YARN



FIG 2 D LIGHT MICROSCOPIC IMAGES OF PASHMINA FIBRES FROM FABRIC

FIG. 2 LIGHT MICROSCOPIC STUDIES ON LONGITUDINAL VIEW OF PASHMINA FIBRES

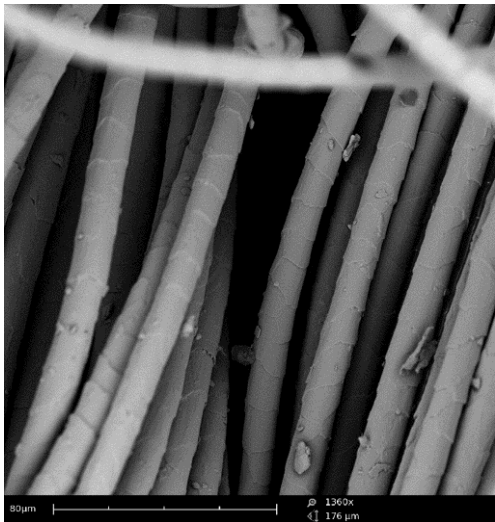


FIG. 3 A PASHMINA FIBRE

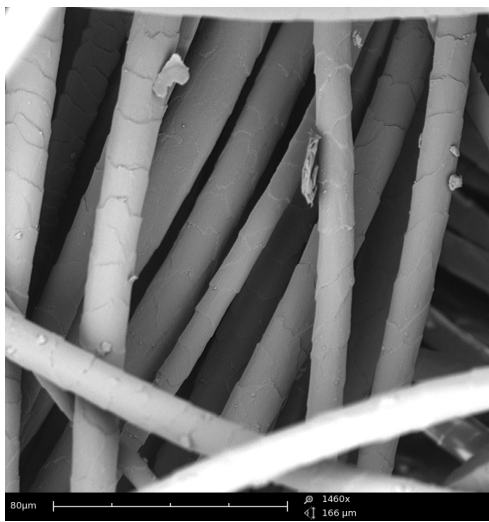


FIG. 3 B PASHMINA FIBRE

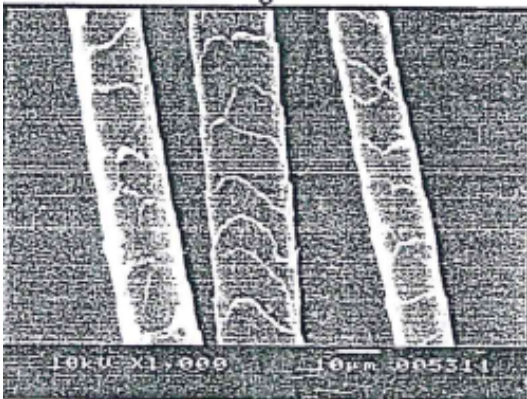


FIG. 3 C VIRGIN PASHMINA LADAKH WHITE

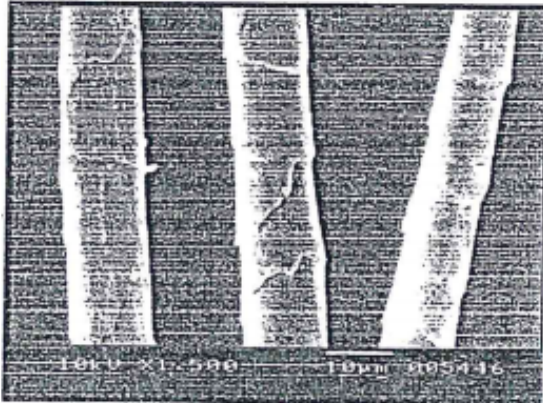


FIG. 3 D VIRGIN PASHMINA LADAKH BROWN

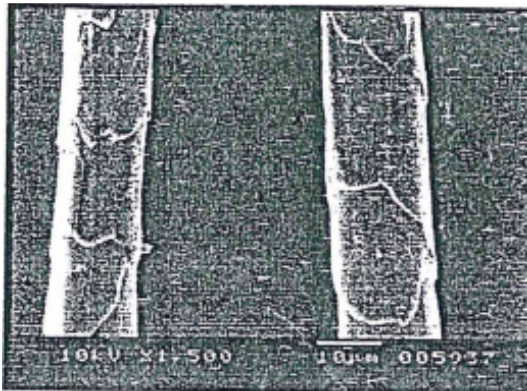


FIG. 3 E PASHMINA LADAKH BROWN
(HAND DEHAIRIED)

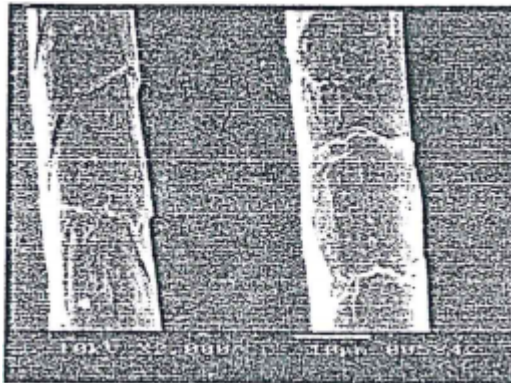


FIG. 3 F PASHMINA LADAKH WHITE
(HAND DEHAIRIED)

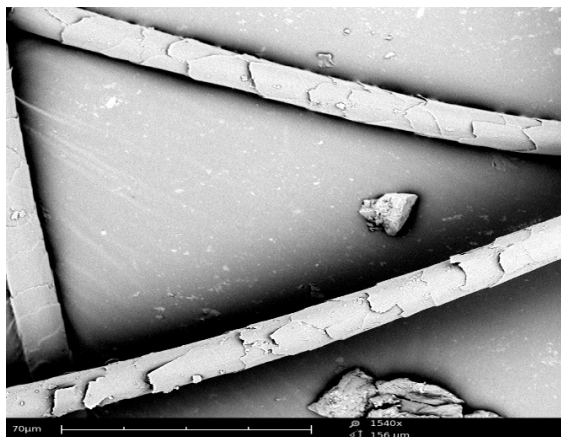


FIG. 3 G PASHMINA FIBRE

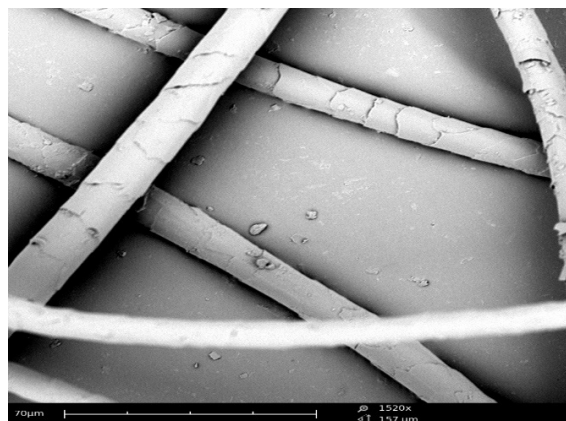


FIG. 3 H PASHMINA FIBRE

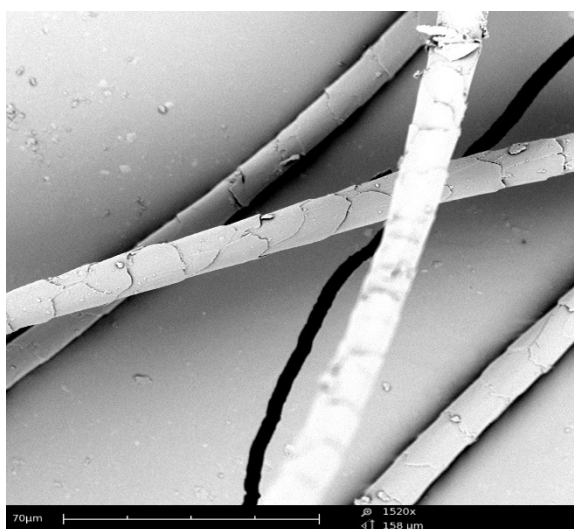


FIG. 3 I PASHMINA FIBRE

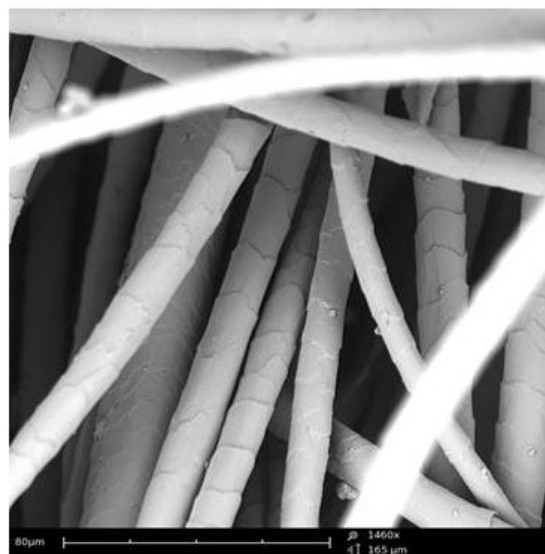
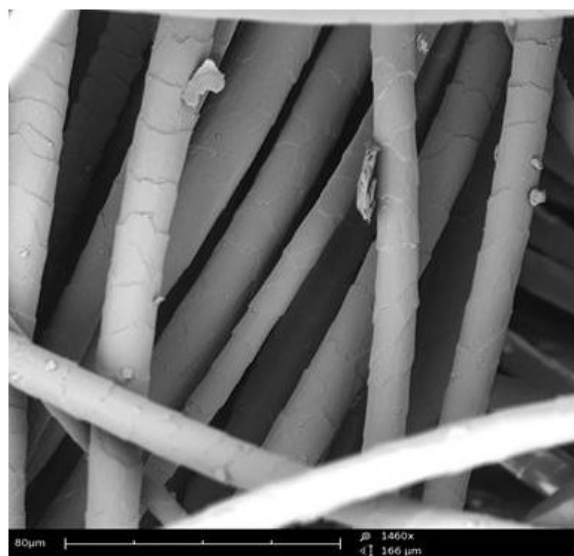


FIG. 3 J SEM IMAGES OF RAW PASHMINA FIBRES

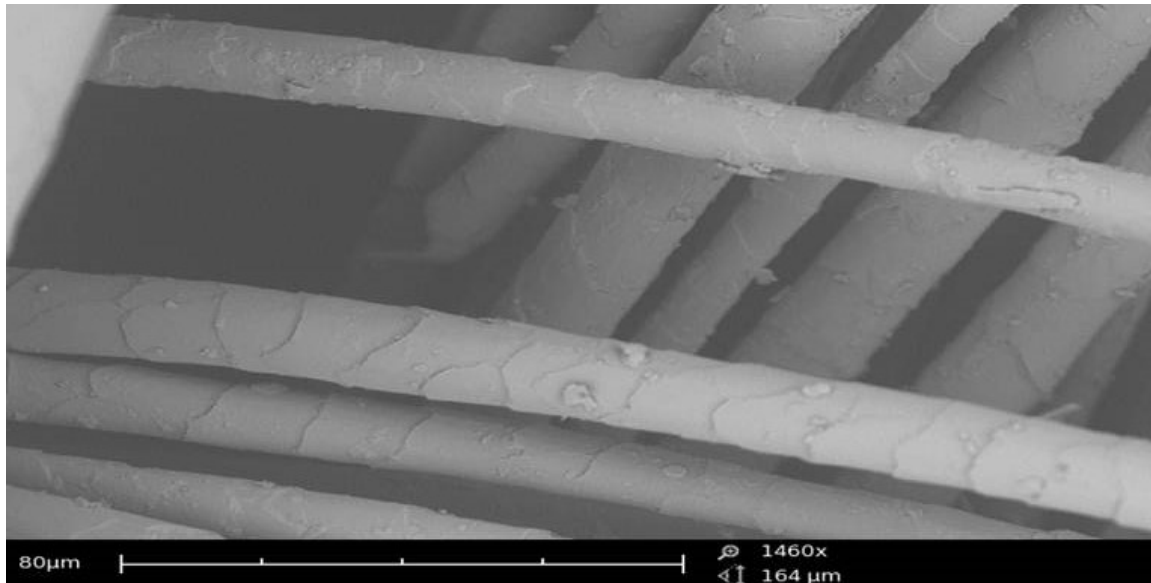


FIG. 3 K SEM IMAGES OF PASHMINA FIBRES TAKEN YARN

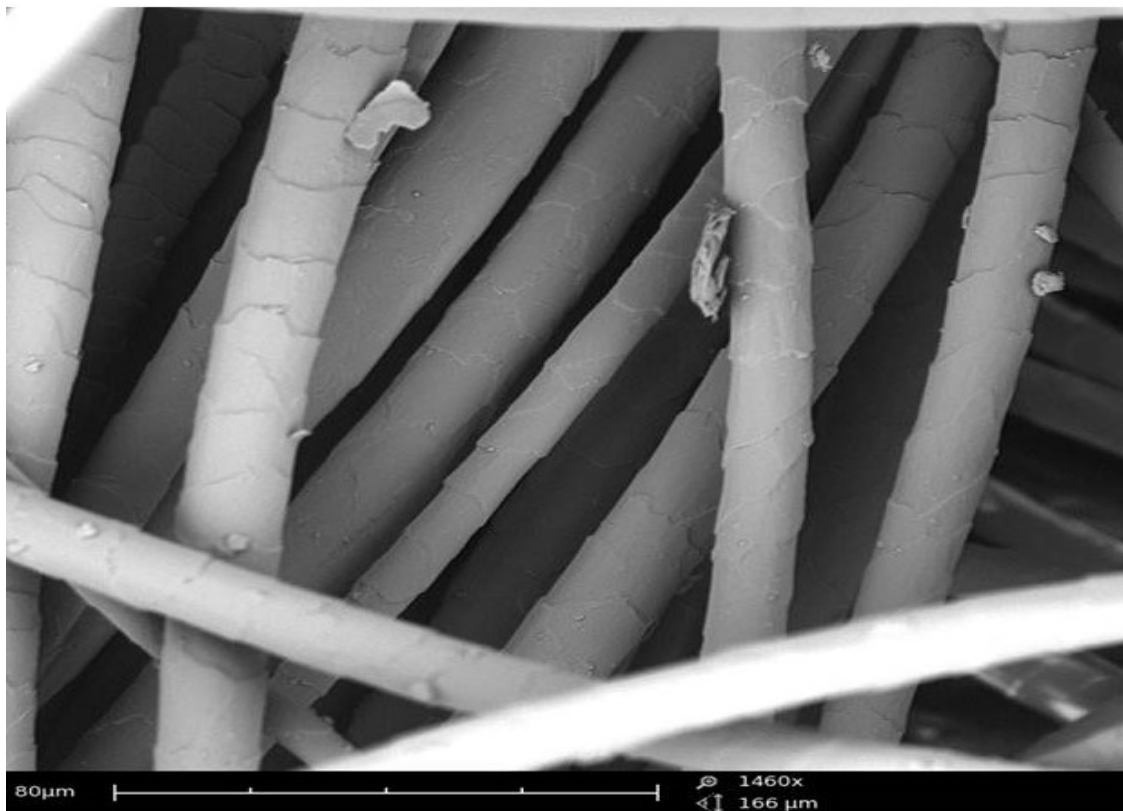


FIG. 3 L SEM IMAGE OF PASHMINA FIBRES FROM FABRIC

FIG. 3 SEM STUDIES ON LONGITUDINAL VIEW OF PASHMINA FIBRES

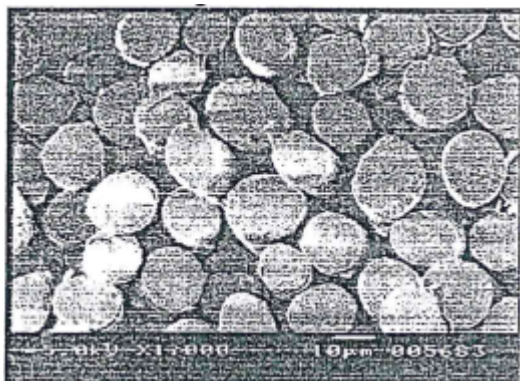


FIG. 4 A VIRGIN PASHMINA LADAKH WHITE

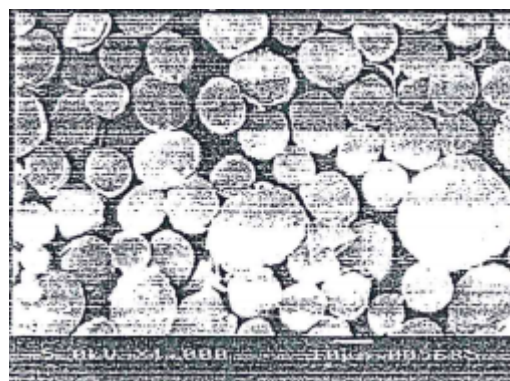


FIG. 4 B VIRGIN PASHMINA LADAKH BROWN

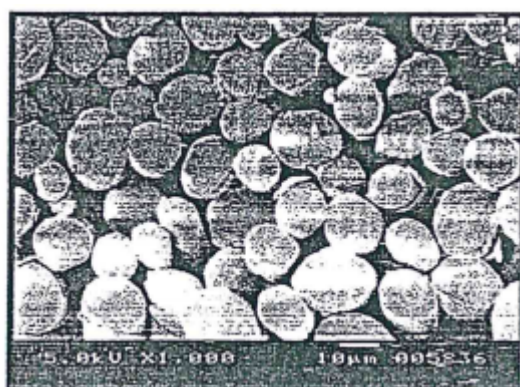


FIG. 4 C PASHMINA LADAKH BROWN
(HAND DEHAIRD)

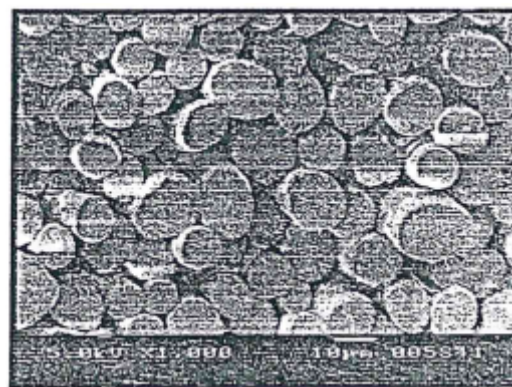


FIG. 4 D PASHMINA LADAKH WHITE
(HAND DEHAIRD)

FIG. 4 SEM STUDIES ON TRAVERSE CROSS SECTION OF PASHMINA FIBRES

ANNEX E

(Clause 5.2.5.3)

PREPARATION OF TEST SPECIMENS, TEST PROCEDURE AND CALCULATION OF TEST RESULTS FOR SCANNING ELECTRON MICROSCOPY METHOD

E-1 PREPARATION OF TEST SPECIMENS

E-1.1 Number of Test Specimens

Prepare five specimen stubs. The fibre snippets on the specimen stubs shall be sufficient to ensure that at least 1 000 fibres are examined.

E-1.2 Preparation Method for Test Specimens

E-1.2.1 Loose Fibre

E-1.2.1.1 Place the laboratory sample flat on the test table, pick up approximately 500 mg of fibres randomly on not less than 20 spots with tweezers from the top and bottom sides of the sample. Blend them homogeneously, and divide them into three equal portions. Sort those drawn fibres into basically parallel fibre bundles.

E-1.2.1.2 Cut the fibre bundle in the middle with a microtome to get approximately 0.4 mm long fibre snippets. Cut only once in each of the fibre bundles.

E-1.2.1.3 Collect all fibre snippets in the glass tube and suspend them in 1 ml to 2 ml acetone or ethyl acetate by stirring the mixture with a stainless steel rod. Pour the suspension onto a glass plate to ensure that the fibre snippets are uniformly distributed on a spot of approximately 10 cm in diameter on the glass plate as shown in Fig. 5.

E-1.2.1.4 Press the double-edged adhesive on the mounting stubs and use a razor blade to trim the tape away from around the mounting stubs. After all the acetone or ethyl acetate in the fibre snippets suspension has evaporated, press the mounting stubs with the adhesive tape end onto the glass plate at the positions shown in Fig. 6. Transfer the uniformly mixed fibre snippets to the adhesive tape on the specimen stub.

If the fibre snippets have aggregated after the evaporation of the acetone or ethyl acetate, they shall be recollected by scraping them off the glass plate with a razor blade and repeat procedures E-1.2.1.3 and E-1.2.1.4.

E-1.2.2 Sliver

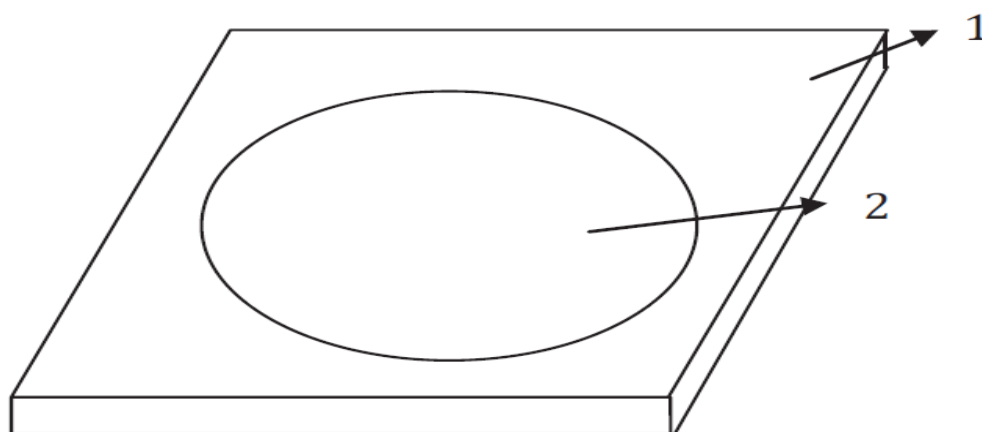
E-1.2.2.1 Cut the laboratory sliver sample into three sections. Take out an appropriate amount of the fibre bundle in the longitudinal direction from each sliver section.

E-1.2.2.2 Cut in the middle of each fibre bundle to obtain approximately 0.4 mm long fibre snippets with a microtome. Cut only once in each fibre bundle.

E-1.2.2.3 Other operating procedures are the same as those stipulated in E-1.2.1.3 and E-1.2.1.4.

E-1.2.3 Yarn

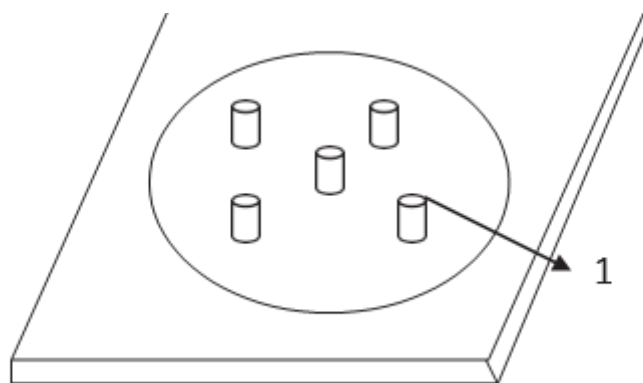
E-1.2.3.1 Divide the laboratory sample into three equal portions.



Key

- 1 glass plate
- 2 fibre snippets

FIG. 5 FIBRE SUSPENSION ON GLASS PLATE



Key

1 specimen stub

FIG. 6 POSITIONS OF SPECIMEN STUBS

E-1.2.3.2 Cut each portion in the middle with a microtome to obtain approximately 0.4 mm long fibre snippets. Cut only once in each yarn portion.

E-1.2.3.3 Other operating procedures are the same as those stipulated in **E-1.2.1.3** and **E-1.2.1.4**.

E-1.2.4 Woven Fabrics

E-1.2.4.1 If the warp and weft yarn share the same composition, all the yarn segments unravelled from a square sample of a complete pattern may be cut to obtain an appropriate test specimen. For those fabric samples composed of different compositions of warp and weft yarns, unravel the warp and weft yarns and weigh them separately. (If the fabrics have a definite repetition in the pattern, unravel at least the integral multiple of a complete pattern).

E-1.2.4.2 Cut once from the parallel yarn portion in the middle with a microtome to obtain approximately 0.4 mm long fibre snippets. Cut only once in each yarn segments.

E-1.2.4.3 Other operating procedures are the same as those stipulated in **E-1.2.1.3** and **E-1.2.1.4**.

E-1.2.5 Knitted Fabrics

E-1.2.5.1 Unravel at least 25 yarn segments from the laboratory sample for woollen knitted fabrics. Unravel at least 50 yarn segments for worsted knitted fabrics. Cut each yarn portion in the middle to obtain approximately 0.4 mm long fibre snippets. Cut only once in each yarn portion.

E-1.2.5.2 Other operating procedures are the same as those stipulated in **E-1.2.1.3** and **E-1.2.1.4**.

E-1.3 Coating the Specimens

Use the sputter coater to apply a thin layer of gold to the specimens on specimen stub.

E-2 TEST PROCEDURE

E-2.1 Test on each Specimen Stub

E-2.1.1 Place a stub with the specimen into the test chamber of the SEM. First, view the selected stub at a lower magnification (for example, at $\times 10$). Then, selecting an area near the upper left edge of the stub on the monitor, set the magnification to $\times 1\,000$, scan the stub and observe the fibres. Identify the pashmina fibre types according to the characteristics of the fibre morphologies (see details in Annex D).

E-2.1.2 Return to the lower magnification after identifying all fibres in the selected area. Choose another observation area along the vertical or horizontal direction. Repeat the above operation until finished, scanning the entire stub before continuing on to analyse fibre snippets on another stub.

E-2.2 Qualitative Analysis (Purity Analysis) and Determination of Fibre Content

E-2.2.1 Examine 150 fibres on the first specimen stub. The following three conditions may happen:

- a) Case 1: If only one fibre type is found, examine another 300 fibre snippets on a second stub. If no fibre of a second type is found, the sample is declared as pure.
- b) Case 2: If two fibre types are found and the amount of one type is lower than 3 percent by number (less than five fibres of the second type), it is considered as a minor component. Examine 300 further snippets from the second stub and calculate the percentage by number of the two types of fibres.
- c) Case 3: If two fibre types are found and the content of each type is higher than 3 percent by number, the fibre mixture is considered to be a blend. Perform a quantitative analysis according to **E-2.2.2**.

E-2.2.2 Quantitative analysis of fibre blends.

If the sample is found to be a blend, examine 220 further fibres and measure the diameters of the first 25 fibres of each component identified (or all fibres of that component, if less than 20) on each of the remaining stubs. At least 1 030 fibres shall be identified for a sample and 100 measurements of fibre diameter made for each component. The mean fibre diameter of each component is calculated according to the diameters measured for the 100 fibres. If the total amount of each component is less than 100, calculate the mean fibre diameter according to the actual number of that fibre component.

This diameter is measured in a vacuum condition and is not comparable to a diameter measured by other instruments. So the value shall only be used for calculation of fibre content of each component in **E-3**.

E-3 CALCULATION OF TEST RESULT

E-3.1 Calculate the mass fraction of pashmina component using Formula (1).

$$w_i = \frac{N_i (D_{i2} + S_{i2}) p_i}{\sum [N_i (D_{i2} + S_{i2}) p_i]} \times 100 \quad (1)$$

where

w_i = the mass fraction of the pashmina component, percent;

N_i = the number of fibres counted for the pashmina component;

S_i = the standard deviation for mean diameter of the pashmina component, in micrometres (μm);

D_i = the mean diameter of the pashmina component, in micrometres (μm);

ρ_i = the density of the pashmina component, in grams per millilitre (g/ml).

NOTE — The density of pashmina fibre is 1.31 g/cm³.

E-3.2 The mass fraction of a pashmina fibre component in woven fabric samples may be calculated through formula (2).

$$w_i = \frac{W_{iT} \times m_T + W_{iW} \times M_W}{m_T + m_W} \times 100 \quad (2)$$

where

w_i = the mass fraction of the pashmina component in the woven fabric sample, percent;

w_{iT} = the mass fraction of the pashmina component in the warp yarns of the woven fabric sample, percent;

m_T = the mass of the warp yarn in the woven fabric sample;

w_{iW} = the mass fraction of the pashmina component in weft yarns of woven fabric sample, percent; and

m_W = the mass of the weft yarn in the woven fabric sample.

ANNEX F

(Clause 5.3.6.2)

PCR AMPLIFICATION OF DNA EXTRACTED FROM DIFFERENT TEXTILES

F-1 PCR products are observed under UV illuminator and photographs are captured in gel documentation system. Gel picture of pre-specified size is determined using commercially available DNA ladders (see Fig 7 and Fig 8).

- 1) Lane 1: Non-template control,
- 2) Lane 2: raw Pashmina,
- 3) Lane 3: Pashmina dyed with natural dye,
- 4) Lane 4: Pashmina dyed with synthetic dye,
- 5) Lane 5: Acid treated Pashmina,
- 6) Lane 6: bleached Pashmina,
- 7) Lane 7: Pashmina treated with PVA,

- 8) Lane 8: 100 bp DNA ladder,
 - 9) Lane 9: Raw sheep wool,
 - 10) Lane 10: Bleached sheep wool,
 - 11) Lane 11: Sheep wool dyed with natural dye, and
 - 12) Lane 12: Sheep wool dyed with synthetic dye.
- 1) Lane 1: 50 bp DNA ladder,
 - 2) Lane 2: Sheep wool specific PCR band,
 - 3) Lane 3: Goat Pashmina specific PCR band,
 - 4) Lane 4: Rabbit hair specific PCR band, and
 - 5) Lane 5: Non-template PCR control.

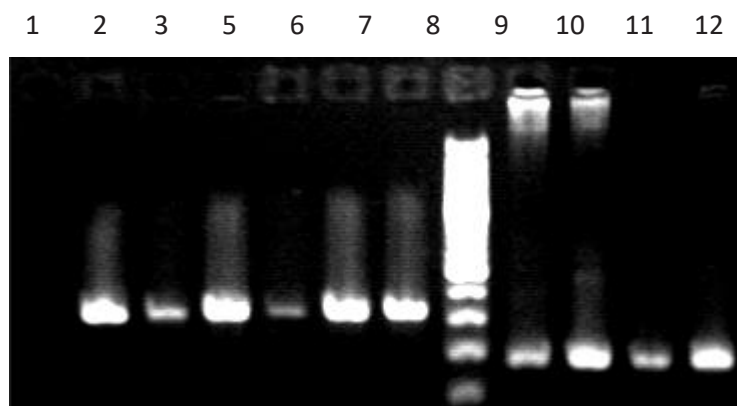


FIG. 7 PCR AMPLIFICATION OF DNA EXTRACTED FROM DIFFERENT TEXTILES

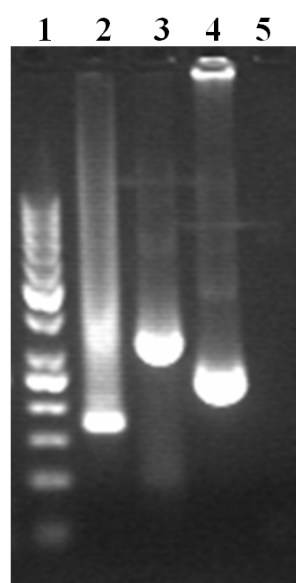


FIG. 8 PCR IDENTIFICATION OF PASHMINA FIBRE FROM TEXTILE BLENDS

ANNEX G

(Foreword)

COMMITTEE COMPOSITION

Wool, Wool Products and Textile Floor Coverings Sectional Committee, TXD 04

<i>Organization</i>	<i>Representative(s)</i>
ICAR-National Institute of Natural Fibre Engineering and Technology, Kolkata	DR D. B. SHAKYAWAR (Chairman)
AgNext Technologies Pvt Limited, Mohali	SHRI TARANJEET SINGH BHAMARA SHRI SALIL LAKHANPAL (<i>Alternate</i>)
Art Weavers Pvt Limited, Varanasi	SHRI HUSAIN JAFAR HUSAINI
All India Carpet Manufacturers' Association, Bhadohi	SHRI RAVI PATODIA SHRI SURENDA K. BARANWAL (<i>Alternate</i>)
Carpet Export Promotion Council, New Delhi	SHRI SANJAY KUMAR SHRI SUBODH KUMAR GUPTA (<i>Alternate</i>)
Central Sheep & Wool Research Institute, Avikanagar	DR AJAY KUMAR DR VINOD KADAM (<i>Alternate</i>)
Central Wool Development Board, Jodhpur	SHRI ANURAG PUROHIT SHRI RAMESH KUMAR BUNDELA (<i>Alternate</i>)
Central Silk Board, Bengaluru	DR S. V. NAIK DR PRAKASH N. BHAT (<i>Alternate</i>)
Craft Development Institute, Srinagar	DR ZUBAIR AHMAD MR YOUNIS FAROOQ (<i>Alternate</i>)
Directorate of Animal Husbandry, Jaipur	DR J. S. SEHGAL
Directorate General of Quality Assurance Ministry of Defence, Kanpur	SHRI A. CHOWDHURY SHRI PURUSHOTTAM DE (<i>Alternate</i>)
Indian Institute of Carpet Technology, Bhadohi	PROF ALOK KUMAR DR BETTY DASGUPTA (<i>Alternate</i>)
Indian Institute of Carpet Technology, Srinagar	DR ZUBAIR AHMAD
Indian Institute of Technology, Delhi	PROF R. CHATTOPADHYAY PROF VIJAY KUMAR BAHETI (<i>Alternate</i>)
Karmabhoomi, Ladakh	SHRI ATUL KUMAR Ms K. DOLMA (<i>Alternate</i>)
Looms of Ladakh, Leh	MRS REGZEN YANGDOL
Laxmi Woollen Mills, Bikaner	SHRI KAMAL KALLA
Office of Commissioner for Khadi and Village Industries Mumbai	SHRI S. K. SINHA SHRI S. P. GUPTA (<i>Alternate</i>)
Office of the Textile Commissioner, Mumbai	SHRI SOURABH KULKARNI SHRI PRANAV PARASHAR (<i>Alternate</i>)
Raymonds Limited, Thane	SHRI PRABHAT PARASHAR SHRI SAURABH SHEKHAR (<i>Alternate</i>)
Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar	PROF SARFARAZ AHMAD WANI DR ASIF HASSAN SOFI (<i>Alternate</i>)
Tahfuz Society, Srinagar	SHRI RAUF WADERA SHRI MOHAMMAD RAFIQ SOFI (<i>Alternate</i>)
Textiles Committee, Mumbai	SHRI J. D. BARMAN SHRI GANESH BANGAR (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
Welspun India, Hyderabad	SHRI PRASAD KULKARNI SHRI DWARKA NATH PANDA (<i>Alternate</i>)
Wool & Woollens Export Promotion Council, New Delhi	SHRI MAHESH N SANIL SHRI SURESH THAKUR (<i>Alternate</i>)
Woolmark Services India Pvt Ltd, New Delhi	SHRI KAUSHIK CHOUDHARY
Wool Research Association, Thane	SHRI SHISHIR TYAGI SHRI MAYUR BASUK (<i>Alternate</i>)
BIS Directorate General	SHRI A. K. BERA, SCIENTIST 'F' AND HEAD (TXD) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary

SHRI DHARMBEER
SCIENTIST 'C' (TXD), BIS

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